Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

PLATE	DATE	HOUR ANGLE	EXPOSURE-RATIOS	
			Blue/Yellow	Blue/Violet
P 3138	1916, June 25	25°W	0.168	0.496
3150	26	1E	0.156	0.542
3163	27	27E	0.178	0.558
3167	27	6E	0.180	0.595
3171	27	15W	0.158	0.600
3173	27	37W	0.164	0.533
3177	27	58W	0.172	0.547
Mean			0.168	0.553
Average deviation from mean			±0.007	±0.027
Change in ratio for 0.1 spectrum interval			0.004	0.014
Spectrum interval corresponding to average deviation			±0.180	±0.190

From the accordance of results for the same star, derived mainly upon different nights, it is found that the average deviation in the exposure-ratio from a single plate corresponds to about 0.2 of a spectrum interval, or 0.08 mag. in the color-index. The greater redness of stars of high luminosity, spectral type remaining the same, is easily seen in the results from even a single plate. The precision seems to be the same whether the yellow or the violet is used for comparison with the blue. As none of the results have yet been corrected for atmospheric extinction, the average deviation includes the effect of this disturbing factor. For illustration the results for seven plates on one of the stars, 72 *w* Herculis, are given in the table.

---

[1] Photovisual magnitudes express the visual brightness of a star, but are determined photographically. The procedure is the same as for the determination of photographic magnitudes, except that an isochromatic plate combined with a yellow filter is used instead of the ordinary photographic plate.

[2] See for example Hertzsprung, *Mt. Wilson Contr.*, No. 100; *Astroph. J.*, **42**, 92 (1915).

[3] These PROCEEDINGS, **1**, 481 (1915).

[4] *Mt. Wilson Contr.*, No. 80, 19; *Astroph. J.*, 39, 325 (1914).

STUDIES OF MAGNITUDES IN STAR CLUSTERS, III. THE COLORS OF THE BRIGHTER STARS IN FOUR GLOBULAR SYSTEMS

By Harlow Shapley

MOUNT WILSON SOLAR OBSERVATORY, CARNEGIE INSTITUTION OF WASHINGTON

Received by the Academy, August 3, 1916

In a former communication dealing with the probable sequence of spectral types in stellar development[1] it was shown that the brightest stars in the great Hercules cluster are of the redder spectral types, while among the fainter magnitudes blue stars were conspicuously predominant. Since all the stars of the cluster are at sensibly the same distance from the earth, the apparent difference in brightness between red and blue stars represents an actual characteristic of the brighter objects of the system. This result, however, is not in harmony with the relations heretofore found between color and intrinsic brightness in the less condensed bright clusters and in other selected groups of stars, and it is of importance to seek verification of the phenomenon in additional globular clusters. If it is proved that in these remote, gigantic stellar systems the most luminous objects are chiefly of the redder, low-temperature spectral types, and consequently of very great dimensions relative to the thousands of other stars each cluster contains, the result may have a significant bearing on theories of the evolution of stars. For instance, a satisfactory hypothesis of the evolutionary sequence of spectral and color classes would need to account explicitly for the ancestral relationships of these extremely voluminous second-type (red) stars and the comparatively small bodies of the bluer types.

Measures of the magnitudes and color indices are now available for stars in three other globular clusters. For none of them is the work completed in all its detail, but the preliminary values, taken in conjunction with final results for the Hercules cluster, are sufficiently definite to justify a report regarding the present problem. The observational material and the final discussion will appear in extended form in the *Contributions from the Mount Wilson Solar Observatory*.

The names of the clusters and their positions for the epoch 1900.0 are given in Table I.

TABLE I

DESIGNATION			RIGHT ASCENSION	DECLINATION	GALACTIC LATITUDE	GALACTIC LONGITUDE
Messier	3.......	N.G.C.5272	13h 38m	+28°53′	8°	+77°
	5.......	5904	15 13	+ 2 27	333	+45
	13.....	6205	16 38	+36 39	26	+40
	15......	7078	21 25	+11 44	33	−29

A number of stars that undergo periodic light variations have been found in these clusters. Such objects were avoided in collecting the results of which a summary appears in Table II. The inclusion of the variables would scarcely change the averages, however, for the plates were taken in pairs and only extremely rapid light changes could enter as systematic errors in the colors. Stars near the center were also omitted from the present treatment in order to avoid possible errors similar to those suspected for the dense central part of Messier 13.[2]

The tabulation of the material needs no general explanation. The photographs now available for Messier 3 do not give a large interval of photovisual magnitude, and consequently, in order to test for the presence of blue stars in this cluster, recourse was had to the short period variable stars. The last average, then, depends entirely on the colors deduced for a number of these variables[3] and, representing a group that is probably peculiar for blueness, is entitled to diminished weight.

The data in Table II show that in these four clusters the average color index is decidedly larger for the brighter stars. Not only is this true in the averages but a detailed examination of the magnitudes involved shows that with few exceptions relatively high luminosity is always accompanied by greater redness. (The exceptions may indicate real anomalies among the members of the cluster, or may be due to the superposed non-cluster stars.) Preliminary consideration of the colors and magnitudes in three additional globular clusters—Messier 4, 9 and 14—shows that the same relation holds for them as that deduced numerically in Table II.

The condition clearly indicated by the above results is that the total light emission of the bluer stars (small color indices), for which the surface temperature is presumably in excess of 10,000 degrees Centigrade, is less than that of many of the redder stars (large color indices),

TABLE II

AVERAGE MAGNITUDES AND COLORS IN FOUR GLOBULAR CLUSTERS

PHOTOVISUAL MAGNITUDE	AVERAGE COLOR-INDEX	NUMBER OF STARS	PHOTOVISUAL MAGNITUDE	AVERAGE COLOR-INDEX	NUMBER OF STARS
Messier 3			*Messier 13*		
12.71	+1.34	10	12.28	+1.28	13
13.34	+1.16	10	13.00	+0.92	23
13.91	+0.88	10	13.50	+0.96	23
14.24	+0.88	9	14.10	+0.73	76
14.51	+0.71	10	14.70	+0.65	110
14.78	+0.73	11	15.30	+0.39	222
(15.20	+0.05	14)	15.70	+0.34	27
			16.45	+0.32	28
Messier 5			*Messier 15*		
12.46	+1.52	6	13.04	+1.35	6
12.93	+1.22	6	13.52	+1.17	7
13.24	+1.20	6	14.19	+0.83	7
13.66	+1.02	6	14.87	+0.86	7
14.42	+0.59	6	15.18	+0.68	7
14.72	+0.44	7	15.54	+0.42	7
14.83	+0.29	7	15.65	+0.32	6

with surface temperatures but half as much. But the light emission per unit area is much less for red stars than for blue. The obvious conclusion is, therefore, that in all these clusters, and probably in all globular clusters, the volumes of the bright red stars are very great in comparison with the stars that are fainter and relatively blue.

[1] These PROCEEDINGS, **2,** 12 (1916).

[2] *Mt. Wilson Contr.*, No. 116, Sections IV and VIII (1916).

[3] *Publ. Astr. Soc. Pac.*, No. 163, April 1916.

THE EFFECT OF AN ELECTRIC FIELD ON THE LINES OF LITHIUM AND CALCIUM

By Janet T. Howell

MOUNT WILSON SOLAR OBSERVATORY, CARNEGIE INSTITUTION OF WASHINGTON

Received by the Academy, August 10, 1916

During the last three years a great deal of work has been done on the electric decomposition of spectral lines. Stark[1] examined the effect in canal rays, subjected to a strong auxiliary field, and Lo Surdo[2] photographed the light immediately in front of the cathode, where the luminosity of the negative glow and the sudden fall of potential fulfilled the required conditions. Hydrogen and helium have been examined by both methods and Stark has investigated the transverse effects for lithium, mercury, and a number of other elements. So far, only H, He, and Li have shown large effects, and the results found for H and He by the two methods differ considerably.

In spite of the great number of data accumulated by Stark, Lo Surdo, and their co-workers since the discovery of the electric effect, the work in this important field is only begun and offers great opportunities for further work. The apparatus used by Stark is very difficult to construct and needs the constant services of a skilled glass blower. Moreover, Stark has already examined most of the more promising elements. The method of Lo Surdo is very simple and has been applied, so far, only to hydrogen and helium. A survey of a number of elements was therefore made with the Lo Surdo form of apparatus, under low dispersion, and in the course of the work some new and interesting results were obtained with calcium and lithium.

A full description of the apparatus used will be published in the *Astrophysical Journal*, but it was essentially of the Lo Surdo form. The tube had an internal diameter of 6 mm. and a length of 20 cm. The discharge from an induction coil was used, rectified by a valve tube. The spectrum was photographed with a three prism, quartz and ultra-